

Claims

What is claimed is:

1. An optoelectronic device comprising at least two spatially separate optical components formed on a single semiconductor substrate, each optical component including an active region, and a passive waveguide formed over the substrate and optically butt coupling the two components.

2. The device according to claim 1 wherein the active regions comprise multi-quantum well layers.

3. The device according to claim 1 comprising at least three optical components of different types.

4. The device according to claim 3 wherein the device comprises a laser, a modulator, and an optical amplifier.

5. The device according to claim 1 wherein each component includes a cladding layer on either side of the active region, and further comprising a cladding layer on either side of the passive waveguide.

6. The device according to claim 2 wherein the multi-quantum layers comprise InGaAsP.

7. The device according to claim 5 wherein each component further comprises a separate confinement layer on either side of the active region.

8. The device according to claim 1 further comprising a stop-etch layer formed over the substrate.

9. The device according to claim 8 wherein the stop-etch layer comprises InAlAs or GaInAlAs.

10. The device according to claim 1 wherein the passive waveguide comprises an identical composition between the components.

11. An optoelectronic device comprising:

at least three spatially separate optical components including a laser, modulator, and optical amplifier formed on a single substrate, each optical component comprising a multi-quantum well layer comprising InGaAsP sandwiched between cladding layers and separate confinement layers;

6 a passive waveguide formed over the substrate so as to form butt joints with the multi-
7 quantum well layers and optically connect the components, the waveguide having an identical
8 composition between the components comprising InGaAsP; and

9 a stop-etch layer comprising InAlAs or GaInAlAs formed over the substrate.

1 12. A method of forming an optoelectronic device comprising the steps of:

2 forming a plurality of epitaxial semiconductor layers on essentially the entire surface of a
3 semiconductor substrate, the layers including at least one layer of an active material;

4 selectively etching the layers to form spatially separate structures including the active
5 material; and

6 forming at least one passive waveguide layer in the etched areas so as to provide optical
7 butt coupling between the active material of the separate structures.

1 13. The method according to claim 12 further comprising, prior to forming the active
2 material, forming an etch-stop layer over the substrate, and selectively etching the epitaxial layers
3 down to the etch-stop layer.

1 14. The method according to claim 13 wherein the etch-stop layer comprises InAlAs or
2 GaInAlAs.

1 15. The method according to claim 12 wherein a plurality of layers including the passive
2 waveguide layer are sequentially formed in the etched areas.

1 16. The method according to claim 12 wherein the active material comprises InGaAsP,
2 and the passive waveguide comprises InGaAsP.

1 17. The method according to claim 12 wherein, prior to forming the passive waveguide, a
2 separate plurality of epitaxial layers is formed for each type of optical component on the
3 substrate.

1 18. The method according to claim 15 wherein the plurality of layers formed in the
2 etched areas includes cladding layers.

1 19. The method according to claim 12 wherein the spatially separate structures are
2 formed into at least a laser, modulator, and optical amplifier.

3 20. A method of forming an optoelectronic device including at least a laser, modulator,
4 and optical amplifier on a single substrate comprising the steps of:

5 forming an etch-stop layer comprising InAlAs or GaInAlAs on a surface of the substrate;

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6 separately forming a plurality of epitaxial layers over the substrate for each of the laser,
7 modulator, and amplifier, the plurality of layers including multi-quantum active layers
8 comprising InGaAsP;

9 selectively etching the plurality of epitaxial layers down to the etch-stop layer to form
10 spatially separate structures;

11 sequentially forming a first cladding layer comprising InP, a passive waveguide layer
12 comprising InGaAsP, and a second cladding layer comprising InP in the etched areas so as to
13 form butt joints between the active layers and passive waveguide layer; and

14 forming the spatially separate structures into the laser, modulator, and optical amplifier.